1.0 INTRODUCTION

This stormwater Field Sampling Plan (FSP) presents the approach and procedures to implement stormwater sampling activities in early 2007 to collect data for the Remedial Investigation/Feasibility Study (RI/FS) of the Portland Harbor Superfund Site (Site). Existing stormwater quality data for the Site are sporadic and relatively limited (Integral et al. 2004). Consequently, estimation of stormwater loads to the river based on existing data or literature values would be highly uncertain. Site-specific stormwater sampling is needed to support stormwater chemical loading estimates for input into the fate and transport model and other estimation tools that will be used in the RI/FS.

The RI/FS project is currently conducting Round 3A of sampling for various purposes in the river, which will extend well into 2007. Therefore, this stormwater sampling is considered part of the Round 3A sampling. This FSP describes the field sampling and laboratory analysis procedures to accomplish the following types of data collection:

- Stormwater chemistry, total suspended solids (TSS), and associated conventionals
- Stormwater sediment chemistry and associated conventionals.

The field study approach, sampling methods, and analyses for stormwater are described in this document.

1.1 BACKGROUND AND CONTEXT

During the fall of 2006, EPA and LWG determined that stormwater data were needed to complete the RI/FS, and that such data would have to be collected in the 2006/2007 rainy season to fit within the overall RI/FS project schedule. They convened a Stormwater Technical Team, which included representatives from EPA, Oregon Department of Environmental Quality (DEQ) and the Lower Willamette Group, to develop the framework for a sampling plan. The sampling framework described in this FSP is based on the December 13, 2006 memorandum (Koch et al. 2006) from the Stormwater Technical Team to the Portland Harbor managers[1] which was discussed and approved by the managers at their December 20, 2006 meeting.

The requirement that the stormwater data collection be completed by the end of the 2006/2007 rainy season (i.e., May/June 2007) had a significant influence on the design of the sampling framework. For example, data collection can only occur over the latter portion of this rainy season and sampling of storm events over several rainy seasons is not feasible.

Given these timing limitations, the Stormwater Technical Team evaluated a range of stormwater data collection technical approaches and selected the ones described in this document based on (1) the ability to meet the objectives for data use (described below) as

[1] Portland Harbor mangers include project managers from EPA, DEQ, Tribes and LWG.

agreed by the Portland Harbor managers and (2) practicability in terms of schedule, cost, and feasibility.

While these discussions were ongoing, the Port of Portland was simultaneously implementing an evaluation of potential stormwater sources and impacts at the Terminal 4 site within the Portland Harbor, where an early action sediment clean up was being designed under a separate EPA-approved work plan. The Terminal 4 stormwater work is intended to address all of the objectives for this FSP as discussed below. Consequently, the Port volunteered to include these Terminal 4 sites within the overall RI/FS stormwater investigation and adjust this work to be as consistent as possible with the approach described in this FSP. Because the Terminal 4 work was designed for a different purpose, there may be minor differences in implementation details; however, the overall methodology and scope are consistent.

When using data generated from this FSP for modeling or other estimation tools, it is important to keep in mind the above limitations. Both the small number of storm events sampled (three events) and the limited timeframe for collecting samples (February through May of a single water year) need to be considered when extrapolating from this data to estimate average annual contaminant loads to the river.

1.2 SAMPLING PURPOSE AND OBJECTIVES

The purpose of this sampling and analysis effort is to provide data for evaluating the potential risk and sediment recontamination threat from stormwater discharges to the river. These data will be used for understanding the magnitude of stormwater impacts to the harbor, developing the draft in-river Site RI, identifying stormwater data gaps, and eventually evaluating remedial alternatives in the Site FS.

The objectives of the stormwater sampling program were developed in coordination with EPA, DEQ, and the LWG. These objectives are defined as:

- EPA/LWG RI/FS Objectives
  1. Understand stormwater contribution to in-river fish tissue chemical burdens.
  2. Determine the potential for recontamination of sediment (after cleanup) from stormwater inputs.

The primary focus of this FSP is to obtain data that meet RI/FS objectives, and the Technical Team devised a sampling framework with this intent. However, the team also considered techniques and approaches that could feasibly provide potential overlapping data uses to help DEQ meet Source Control Objectives as described in the EPA/DEQ Joint Source Control Strategy (include reference). These objectives are defined as:

- DEQ Upland Source Control Objectives

1. Evaluate stormwater discharges to identify potentially significant hazardous substances that could reach the river.
2. Identify, prioritize, and control stormwater sources as necessary to prevent contamination of Willamette River water and sediments and recontamination of river sediments following the Portland Harbor cleanup.

The RI/FS objectives as they relate to this FSP are discussed in more detail below.

It should be noted that in addition to the stormwater data collection described in this FSP, DEQ is pursuing collection of stormwater data at a number of Portland Harbor sites as a part of the Joint Source Control Strategy (JSCS) to meet the above source control objectives. Stormwater data are also being collected by National Pollutant Discharge Elimination System (NPDES) permittees in Portland Harbor. As these data become available, they will be used wherever possible and technically defensible to augment the estimations of stormwater loads based on data collected as described in this FSP to help meet the above RI/FS objectives.

1.2.1 Stormwater Contribution to Fish Tissue Burdens

Surface water chemicals are suspected to contribute to fish tissue burdens (and related risks) in the harbor. The importance of various sources of surface water chemicals, particularly stormwater, is not well understood. This lack of understanding could make it difficult to accurately determine sediment (and water) preliminary remediation goals (PRGs) that are intended to minimize fish tissue related risks for the Site.

Thus, it is necessary to determine the relative contribution of stormwater (as compared to other sources) to surface water concentrations of selected chemicals in the harbor. As noted above, this would be done for stormwater in terms of loading estimates. To understand the relative contribution of stormwater chemicals to fish tissue burdens other sources of chemicals also need to be understood. Other potentially important sources to the water column and fish tissue that are currently being investigated by the LWG are contributions from upstream and from in-river sediment chemicals.

1.2.2 Stormwater Contribution to Recontamination Potential

Stormwater discharges have the potential to contribute to recontamination of sediments near outfalls (and/or potentially harbor-wide for some chemicals) after cleanup has been completed, if the discharges contain contaminants attached to settling solids. The potential for this outcome must be assessed at an FS-appropriate level of detail to understand the general extent and need for stormwater source controls.

To predict whether sediments would recontaminate at levels above PRGs eventually set for the site, estimates of stormwater loads are needed for input into estimation tools and models described in Section 1.4. These load estimates must be on a spatial scale consistent with those estimation tools and models. The load estimates should be accompanied by sufficient site-specific measures to assist in the estimation of chemical mass associated with particulates (that may settle to the sediment bed) versus dissolved mass.

Commented [ket3]: Not sure what you mean by this.

1.3 SAMPLING FRAMEWORK

This FSP describes the approach for measuring the concentrations of chemicals in stormwater and for obtaining stormwater flow data at 31 select locations in the Site to meet the above objectives. These data will be used, in conjunction with estimation and evaluation tools described below, to assess the nature and extent of chemical loading from stormwater discharges to the site. In summary, the sampling approach involves:

1. Flow-weighted composite water samples from three storm events including whole water for organic compound analyses and filtered/unfiltered pairs for metals analyses.

2. One additional set of grab stormwater samples at 10 of the 31 sampling locations for sampling of filtered/unfiltered pairs and analysis of selected organic compounds to obtain partitioning data that can be used to validate model algorithms.

3. Sediment trap deployment and sampling for a minimum duration of 3 months.

4. Continuous flow monitoring at each sampling site for the duration of the sampling effort.

The rationale for this sampling approach to meet RI/FS objectives and details of each element of the approach is described in more detail in the remainder of this document.

1.4 SAMPLING RATIONALE AND DATA USE

Several estimation and evaluation methods and tools will use the collected data to meet the above objectives. The modeling tool of primary consideration is EPA's Fate and Transport Model described by Hope (2006). This tool is being used by DEQ to help identify and prioritize the stormwater sources that may require source control measures. It is also being used by EPA/LWG in combination with the LWG-developed in-river Hydrodynamic and Sedimentation Model (West 2005) to directly evaluate the RI/FS objectives above. In summary, these models require estimates of the chemical mass load (e.g., kg/yr) from each type of contaminant source (e.g., stormwater, groundwater, upstream, etc.) for each of the model-defined segments of the river.

1.4.1 Rationale and Sampling Locations

In general, to estimate stormwater loads, a chemical concentration in stormwater and the volume of stormwater discharge (i.e., time-integrated flows) must be known. These terms can be either directly measured or estimated through indirect means (e.g., runoff modeling of stormwater volumes).

Because of the large number of outfalls present at the Site, it is not feasible to collect data at each outfall. Consequently, this FSP employs the commonly used approach of applying "representative" estimates of stormwater pollutant concentrations for various land use types (Scheuler 1987). However, this approach has been modified to better fit the unique data needs and land use characteristics of the Site, as well as the practical constraints for this sampling effort as described previously in this document.

Key considerations contributing to the design of this FSP include the following:

While there are well-substantiated estimates of land use-based pollutant loading rates available from both local and national stormwater management agencies, these estimates generally do not include data on key Portland Harbor Contaminants of Interest. Additionally, the loading rate estimates were developed to meet data needs related to general water quality objectives, which are significantly different from the Portland Harbor data objectives described earlier in this document.

Industrial land uses are of particular concern at this Site. When compared to other land uses at the Site (e.g., residential, commercial, open space), industrial land uses are expected to have higher loading rates of Portland Harbor COIs and may generate runoff with unique chemical characteristics depending on the particular industrial activities taking place at that site. This results in a high degree of variability in stormwater contaminant concentrations for this land use. Thus, caution is needed when using "representative" contaminant concentrations to extrapolate loading estimates from unmeasured drainage basins. Representative concentrations may be applicable for some industrial sites but not for others.

Although all outfalls cannot be directly sampled, the number of outfalls that need to be extrapolated using representative loading rates can be minimized by directly measuring loads. This can be addressed by giving preference to sampling locations as close to the outfall discharge point as possible, while taking into account any physical limitations, and maintaining the approach of isolating certain land uses within a reasonable subset of the sampling locations. Similarly, where one location at or near a basin's discharge point can be sampled, this would be preferred to extrapolating loads based on land use from many other sampling points outside the basin.

Given these and other considerations, it was decided that a three-pronged approach would be used to balance the need for a robust data set with the feasibility and cost of data collection and the time constraints for this data collection effort. Thus, a subset of drainage basins/outfalls will be sampled. These basins fall into the following categories.

1. Eleven (11) locations selected as representative of certain types of land use within the overall drainage area as follows[2]:
    - Residential
    - Major transportation corridors
    - Heavy industrial
    - Light industrial
    - Open space

Commented [KT6]: After each category, insert the estimated percent of total land area in parentheses.

2. Eleven (11) industrial locations with unique or unusual potential chemical sources that cannot be easily extrapolated from generalized land use measurements.
3. Two (2) locations selected to directly measure stormwater discharge from relatively large basins that have a mixture of land uses and activities within them.

In addition, there are seven (7) sampling locations associated with the Port of Portland's Terminal 4 recontamination study which is currently underway. This sampling is subject to a separate agency approved work plan and has been designed to meet both RI/FS and source control objectives Section 1.1. While some of the implementation details of the Terminal 4 are slightly different than described in this FSP, the overall sampling approach is the same (sediment traps, sampling of three storm events with total and dissolved analyses) and the data generated will be consistent with those generated at other locations. Data from these locations will be used similar to that described above for "land use-based" locations using the categories identified in Table 2-1. However, the data from heavy industrial type locations will be evaluated to determine if any of these locations exhibit unique or particular chemical signatures related to specific industrial activities on these sites. If so, data from these locations may be evaluated as "unique" sites, where only some locations or chemicals are used in the land use based extrapolations to Site-wide loads.

1.4.2 Data Use

Contaminant concentration data from the first category of locations (representative land use sites) will be pooled by land use type to arrive at contaminant concentrations that are presumed to be representative of each land use category. These values will be used to estimate loading for other unsampled areas with the same land use.[3] For example, stormwater chemical concentrations measured from residential land use areas will be applied to other unsampled residential land use areas and converted to extrapolated loads

[2] Note another kind of land use commonly evaluated in stormwater investigations is the "commercial" category, but this is a very minor use within the overall drainage and was judged not to warrant a specific sampling location.
[3] Because industrial sites are expected to demonstrate a higher degree of variability in contaminant concentrations than other land uses, the list of sampling sites includes a higher proportion of industrial land use sites in an attempt to better capture this variability.

based on the estimated volumes of stormwater discharged from those unsampled areas. The resulting series of extrapolations will provide total stormwater loads for these land uses across the entire Site that can be input into the fate and transport model and other estimation tools.

Contaminant concentration data from the second category of locations (unique industrial sites) may be used in two ways. First, the data will be used to develop loading rates for that specific site. Second, at sites where the unique chemical character of stormwater only applies to a certain type or types of chemical (e.g., significantly higher metal concentrations from a metals handling facility), the other chemicals measured at this site might be pooled with the land use data as described above. In general, the data reduction approach for unique industrial sites is expected to entail pooling the data for each parameter (TSS, water chemical concentration, and sediment chemical concentration), removing the high outlier data (i.e., unique sites) and combining the remainder with data from the land use sites to generate a heavy industry value for use in extrapolation to non-sampled heavy industry areas. Thus, data collected at the “unique” industrial sites should not be viewed as exclusively useful only to directly measure concentrations from these particular sites as this data may have wider application to the study.

The third category of locations (basins with a mix of land uses) will not be used in land use loading estimates because these locations measure a variety of land uses in one sample. These results will be used as an independent cross-check of extrapolated loads to help gauge the potential differences between the two methods and uncertainties in the overall approach. For example, the extrapolated approach does not account for changes in stormwater quality that could occur between the time that an inland site discharges to a shared conveyance and the time when the combined stormwater flow is discharged into the river.

The exact methodology for using measured data and extrapolating data to unsampled outfalls or model segments for RI/FS purposes is the subject of ongoing discussions between EPA, DEQ, and the LWG. As this effort moves forward, the limitations of the data set generated using the methods described above need to be taken into consideration. For example, the land use estimates are a general representation or “average” estimate of the potential loads from these types of land use. This approach can be inaccurate if substantial unusual conditions lay within any of the unsampled areas. Also, there are limitations to using such data on a small scale since “averages” do not capture the variability that can occur within the overall landscape.

1.4.3 Measurement Methods

As noted above, both water samples and stormwater sediment samples will be collected. These two measurements will provide data to support two independent means of estimating stormwater loads. For whole water chemical concentrations (mass chemical/volume water), these values are multiplied by the volume of water discharging at the location over a set time to yield a load in mass/time. For sediment chemical concentrations (mass chemical/mass sediment), these values are multiplied by TSS concentrations (mass sediment/volume water) measured in water samples to yield a chemical concentration in water (mass chemical/volume water). This water chemical concentration can then be used to estimate loads identically as described for directly measured water chemical concentrations.

It is anticipated that these two methods will result in different predictions of mass loading at most sites. The reason for having two independent methods to estimate loads is that each method has some intrinsic measurement artifacts that will lead to varying load estimates. The advantages and disadvantages of each method are to some extent complimentary. By using two approaches, the disadvantages of each method can be better understood and the two loading estimates compared to provide a better overall sense of the potential range of chemical loads.

The primary advantage of stormwater sampling is that it provides a direct measure of the chemical concentrations in the water that can be converted to a load in one step (multiplication by volume discharged over a unit time). The disadvantage of stormwater sampling is that it captures one relatively small condition in time. Stormwater chemical concentrations are known to be widely variable depending on a variety of factors such as:

- The specific chemical sources within the drainage basin, which may vary over time and location within the basin
- The characteristics of the storms and their associated runoff (i.e., antecedent dry periods; storm amounts, intensity, and durations; stormwater collection system characteristics; and presence, condition and proper functioning of source controls)
- How and where stormwater is sampled
- When in the storm the samples are collected (i.e., first flush, rising limb, falling limb, etc.)

Ideally, estimation of long-term loads would involve a large number of water samples taken over the course of many years and many types of storms, pollutant sources, and runoff conditions. However, such an approach is rarely acceptable in terms of schedule or budget and is infeasible for this project. Consequently, methods that integrate, average, or estimate long-term chemical concentrations and flows over time are preferred. For this reason, water sampling for this project will be conducted using composite sampling techniques, where a large portion of a runoff event is sampled, rather than one or two grab samples within that runoff event.

Another disadvantage of composite stormwater samples is that analytical detection limits may not be adequate to detect COIs that tend to be present in stormwater at very low concentrations, such as PCBs. This is one of the main reasons for including sediment traps in this sampling effort. If sediment traps are left in place long enough, they can accumulate a large enough sediment sample to reduce the likelihood that analytical limitations will be a barrier to meeting data quality objectives.

The other advantage of sediment traps is that they integrate the particulate associated chemical loading over time and avoid the need for large numbers of water chemistry samples. The disadvantage of sediment traps is that (1) they do not estimate the dissolved load and (2) they may preferentially capture only portions of the particulate load (e.g., coarser TSS fractions). Thus, they provide a much less direct measurement of the overall load that may be present in the stormwater being discharged.

Information on grain sizes in sediment traps could be useful in understanding the potential for particulate associated stormwater pollutants to settle and recontaminate river sediments. However, due to expected sediment sample volume limitations, it was necessary to rank the analytes in priority order, and grain size analysis was given the lowest priority so that it did not jeopardize the analysis of COIs. Because of these logistical considerations, grain size data will likely be obtained for only a subset of sediment samples collected.

The sampling framework includes certain elements deemed necessary to vet modeling assumptions and calculation methods. One particular data need of this type is collection of filtered and unfiltered stormwater samples to help validate the partitioning algorithms used in the fate and transport model and other estimation tools. Such samples will be collected at all sampling locations and analyzed for metals on the analyte list, because site-specific metals partitioning is difficult to predict based on literature information. In addition, limited grab sampling of filtered/unfiltered water will be conducted at a subset of sampling locations and analyzed for organic compounds to provide information on the range of partitioning characteristics for these chemicals. The partitioning of organic compounds is generally more predictable based on literature information, but some limited data collection for organic compounds will help validate these predictions.

1.4.4 Flow Information

Each of the various methods of estimating loads discussed above require some estimate of the volume of water discharged over unit time, which is defined as flow. Flow information will be collected at each location during the duration of the sampling effort. However, the primary use of this flow information will not be in the calculation of stormwater chemicals loads because:

- The period measured is only a portion of the year and loads will need to be estimated on an annual basis
- There will be insufficient time to calibrate flow measurements at each location to arrive at an accurate measurement of flows over the period measured.

The primary purpose of the flow measurements will be to assist in the composite sampling of stormwater on a flow-weighted basis. Flow weighted composite methods are described more below. In summary, the amount of sample taken is proportional to the flow of water present over the time period the sample is intended to represent. Each sample is then combined so that the composite sample is “weighted” based on the flow.

Volumes of water for use in loading estimates will be estimated by independent methods currently being discussed by the Stormwater Technical Team. In general, average annual volumes of discharge for each sampling location will be estimated using runoff estimation and modeling tools that are commonly applied to stormwater loading and conveyance system design.

1.4.5 Additional Considerations

Some other techniques and conditions were considered in the sampling design but not selected. The reasons for such selections are discussed briefly below.

Sediment traps were selected as the method to measure chemical concentrations on stormwater particulates. Other methods exist to obtain sediment samples such as pumping and filtering large amounts of stormwater and analyzing the solids captured by the filter (and similar methods of capturing particulates in water). Sediment traps were preferred because they are logistically simple to implement and passively capture sediment over a long period and wide range of conditions. By comparison, active filtering or capturing techniques are labor intensive and sample over a relatively short period of time, such as hours or perhaps a few days, and thus, have the same time integration limitations as composite stormwater sampling. However, high volume water filtering techniques will be employed if sediment trap deployment is infeasible (e.g., due to space limitations) and are described as a contingency method within this FSP.

The Stormwater Technical Team determined that TSS should be measured in stormwater to support the loading calculations based on sediment trap data as described above. Various methods exist for measuring particulates in stormwater including Suspended Sediment Concentration (SSC) methods developed by the U.S. Geological Survey (USGS). The SSC is reported by the USGS to provide a more accurate determination of the suspended sediment mass in water samples than TSS (Gray et al. 2000). However, TSS method is much more widely used and any historical data sets available for the sampling locations will likely be in the form of TSS. Because this historical information may be valuable in better estimating the range of suspended sediment conditions that might apply to estimates of chemical loads using sediment trap data, it appeared more important to collect any additional suspended sediment data for this program by a consistent means. Consequently, it was determined that the biases introduced by the TSS method are not so great as to warrant the inability to compare historical and new data sets.

The Stormwater Technical Team determined that three composite storm events would be sampled at each location. Greater and lesser numbers of events were considered. Given the time limitations of the study, three events appeared to represent a good balance between the preference for as many stormwater samples as possible to address the variability issues discussed above, the allowable timeframe for the sampling, the number of appropriate storms that would occur in that period, and costs. Once the data generated through this FSP is available, it will be evaluated along with other RI/FS and source control information to determine whether there are stormwater data gaps that will need to be addressed through additional stormwater data collection in the future.

1.5 DOCUMENT ORGANIZATION (WILL NEED TO BE REVISED)

The remaining sections of this document describe the sampling plan and field procedures that will be used to collect stormwater and sediment samples:

- Section 2 describes the sampling design and rationale.
- Section 3 summarizes stormwater sample collection, processing, and measurement procedures for stormwater samples, sediment samples, and stormwater flows.
- Section 4 describes the sampling implementation and schedule including contingency procedures that may be employed to collect data.
- Section 5 summarizes how the data will be reported.
- Section 6 provides references.

Detailed standard operating procedures (SOPs) for sampling and flow measurements are provided in appendices. The appendices also contain a Chain of Custody SOP, field sampling forms, and health and safety procedures and are organized as follows:

- Appendix A Stormwater Composite Sampling SOP
- Appendix B Stormwater Grab Sampling SOP
- Appendix C-1 Sediment Trap Sampling SOP
- Appendix C-2 Stormwater Filtering for Sediment Collection (Back Up Procedure)
- Appendix D Flow Meter Measurements
- Appendix E Field Forms
- Appendix F Chain of Custody SOP
- Appendix G Laboratory Protocol for Extraction and Analysis of Large Volume Water Samples
- Appendix H Confined Space Health and Safety Plan Addendum

2.0 SAMPLING PLAN

The sampling plan includes three types of measurements, as described below. In addition, Table 2-2 summarizes the proposed stormwater sampling types, numbers, and analyses, and Table 2-3 summarizes the priority order of sampling of analytes for each sample type and the approximate sample volumes that will be needed for these analyses. The analytical concentration goals achievable with these sample volumes are discussed more below. .

Stormwater Composite Samples. Flow-weighted composite samples of three storm events from each location will be collected to obtain Event Mean Concentrations (EMCs) of constituents of interest. Flow-weighted, whole water (unfiltered) sample aliquots will be collected over the course of the storm event with automatic samplers. These whole water samples will be collected by the sampling teams, identified in Section 4, and transported to the LWG Field Laboratory. At the LWG Field Laboratory, sampler performance will be evaluated and the water from the individual sample bottles will be combined and mixed in a single container. Whole water samples for organic compounds, and unfiltered/filtered water pairs will be prepared for metals and total organic carbon (TOC)/dissolved organic carbon (DOC) by the sampling teams from the combined composite sample. Samples will also be prepared for analysis of TSS concentrations. Each sample will be analyzed for the chemicals shown in Tables 2-2 and 2-3. In addition, the priority order and list of chemicals analyzed will vary somewhat between locations as shown in Table 2-4a for reasons discussed below.

Organochlorine pesticides will be analyzed in composite water samples at the following sites given their potential source histories:

- WR-96 – Arkema
- OF-22B – Chemical manufacturing
- WR-6 – Rhone-Poulenc

Only a subset of sites will be analyzed for phthalates because of the logistical difficulties of avoiding phthalate contamination from field sampling equipment and laboratory analysis. Through Technical Team discussions, it was determined that it was appropriate to analyze for phthalates at those locations where there was a reasonable potential for phthalate related in-river risks that might be linked to upland sources. In addition, as a cross check on the assumptions behind potential phthalate sources, analyses should also be conducted for some locations that were not known or suspected phthalate sources. The preliminary risk evaluations currently underway by the LWG were reviewed for potential phthalate related risks near any of the proposed stormwater sampling locations. The following list of sites for phthalate analyses containing both potential and unlikely sources of phthalates was determined from the above research:

- WR-24 – Oregon Steel Mills
- WR-121/123 – Schnitzer

- WR-96 – Arkema
- WR-161 – Portland Shipyard
- WR-145 – Gunderson
- WR-148 – Gunderson (former Schnitzer)
- OF-M2 – City Light Industrial Basin
- OF-17 – City Multiple Land Use Basin
- St. Johns Bridge – Oregon Department of Transportation (ODOT)
- OF-49 – City Residential Basin
- OF-22C – Upstream at Forest Park (Open Space Land Use)

Also, phthalate analyses will take place at some Terminal 4 locations to be determined in consultation with the Port. This results in a total of 11 locations known at this time that will receive phthalate analyses (Table 2-4a).

The target storm conditions for sampling are: storms predicted to produce more than0.2 inches rainfall over a minimum of a 3-hour period, not to exceed approximately 2.25 inches in a 24 hour period (equivalent to the 2-year event), and to have been preceded by at least a 24-hour dry period (less than 0.1 inches rainfall). National Oceanic and Atmospheric Administration (NOAA) storm predictions will generally be used in the evaluation of storms potentially meeting these criteria (http://www.wrh.noaa.gov/forecasts/graphical/ sectors/pqrWeek.php#tabs). For each sampling location, drainage basins will be evaluated for basin size and runoff characteristics to facilitate calculation of expected discharge flows for a variety of storm conditions meeting the storm criteria. Samplers will be programmed to collect aliquots of stormwater following the discharge of the calculated "trigger volume" for each storm event. The objective is to get a composite sample that represents aliquots collected into seven 1.8-liter bottles over the entire storm hydrograph (the eighth bottle in the sampler will be used for quality assurance/quality control [QA/QC]). This is the primary reason for the approximate maximum on the storm criteria above. However, this is only an approximate guideline that will be considered in the above evaluation of expected discharge flows and may be modified at one or more sampling locations. If storm flows exceed expected volumes, the sampling period will be concluded when the sample bottles are full and thus in some cases, the falling limb of the storm hydrograph may not be sampled in its entirety.

Stormwater Grab Samples. During one storm event, discrete stormwater "grab" samples will be collected from 10 locations where it is most likely that organics would be detected in water samples. Because the purpose of the grab samples is to collect partitioning rather than loading data, samples will be collected during storm periods expected to have higher COI concentrations (e.g., first flush or rising limb), to increase the likelihood of detecting low level COIs. While all samples will be analyzed for TOC/DOC constituents, the sampling locations were selected based on general knowledge of site uses and potential sources. The following list (and in Table 2-4a) of locations, spanning the likely primary chemicals of concern for the harbor, was determined for this sampling:

- WR-24 – Oregon Steel Mills (PCB[4]s/phthalates)
- WR-121/123 – Schnitzer (PCBs/phthalates)
- WR-96 – Arkema (DDx/phthalates)
- WR-107 – Gasco (PAHs)
- WR-145 – Gunderson (PCBs/PAHs/phthalates)
- St. Johns Bridge – ODOT (PAHs/phthalates)
- OF-17 – Industrial/Residential/Open Space Land Use (PCBs/PAHs/phthalates)
- OF-22B – Heavy Industrial (pesticides, various)
- WR-161 – Portland Shipyard (phthalates)
- OF-22 – Willbridge (PAHs)

Also, all composite samples for the Terminal 4 sites will include filtered and unfiltered pairs for all chemicals analyzed including organic compounds.

The sample teams will collect the required quantity of water and transport it to the LWG Field Laboratory, where one aliquot will be filtered and distributed appropriately to bottles for laboratory analyses and a second aliquot will be distributed directly to bottles. Sample will be analyzed for the organic compounds shown in Table 2-4a and TSS. Additionally, organochlorine pesticides will be analyzed at Arkema, OF-22B, and Rhone-Poulenc (Table 2-4a). Because filtering methods (e.g., filter matrix) differ between organic compounds and metals, metals will not be filtered and analyzed for these grab samples. Storm conditions for grab sampling are the same as for composite sampling described above, with grab samples taken sometime in the rising limb of the hydrograph of a continuous storm meeting the above requirements.

Sediment Samples. Sediment traps will generally be installed at each sampling location as close to the outfall as possible and downstream of the automatic sampler. Figure 2-2 presents a photograph of a prototype of the sediment trap that will be deployed. The sediment trap will be placed adjacent to the outlet of the stormwater facility with the opening of the collection bottle at the same elevation as the invert of the outlet. Some sampling locations may require the use of sandbags or structural modifications to generate flow conditions conducive to sediment trap sampling. These sediment traps will be deployed at each location for a minimum target period of 3 months. Sediment traps will be inspected at a minimum on a monthly basis. When inspected, if the collection

[4] All references to PCBs throughout this document refers to the analyses of PCB congeners (as opposed to PCB Aroclors).

bottle more than half full of sediments, the bottle will be collected and archived and an empty collection bottle will be returned to the trap. If the collection bottle is less than one third full at the first monthly inspection, options for repositioning or relocating the equipment or adding additional traps to obtain a better collection rate will be considered.

At the end of the deployment period, all sediments for each location will be combined and homogenized and sampled for analyses in the priority order shown in Tables 2-3 and 2.4b as the available sediment volume allows.

In Tables 2-3 and 2-4b, analytes are ranked in priority order in the event that any collected sample size is insufficient to run all analyses. Given that some industrial sites are not known or suspected sources of organochlorine pesticides, but are potential sources for PAHs and phthalates, the priority order of these two chemical classes will be reversed for the following locations:

- WR-24 – Oregon Steel Mills
- WR-121/123 – Schnitzer
- WR-109 – Schnitzer Riverside
- WR-107 – Gasco
- WR-14 – Chevron
- WR-161 – Portland Shipyard
- WR-4 – Sulzer Pump
- WR-148 – Gunderson (former Schnitzer)

Grain size is the last priority analyte. As discussed above, it is unlikely that large enough samples for grain size analysis will be obtained at most locations.

Also, due to physical constraints, it may be impossible to deploy sediment traps at some locations. Contingency procedures in the event of this problem are discussed more in Section 4.3. One possible contingency measure is to pump and actively filter sediments from large volumes of stormwater at some sites. This contingency technique is also described in Section 3.5.2.

Flow Measurements. Isco Model 750 Area Velocity flow modules will be used in conjunction with the Isco automatic samplers to allow the collection of flow-weighted composites at each sampling location. The flow modules will also continuously record flow data for the duration of sediment trap deployment. As discussed in Section 1, flow meter precision or performance may not generate accurate discharge volumes for the entire monitoring period and will not be used to determine annualized loading estimates. However, flow data from the period measured will be evaluated in conjunction with modeled discharge volumes modeled from the same period to understand potential variability and accuracy issues associated with estimating annualized loading from modeling methods.

All sampling equipment will be deployed at locations that are as close to the point of discharge (for outfall locations) or the last junction[5] associated with the land area of interest (for the land use based locations). In all cases, equipment will be placed at elevations sufficient to minimize the potential for river water to back up to the sample location and compromise flow data quality, the integrity of the sediment traps and collection of true stormwater sample

[5] The term "junction" refers to any accessible location where two or more pipes are joined by a structure such as a manhole. This may include locations where drainage from surface runoff also enters the junction, such as catch basins that connect two or more pipes.